

Claims:

1. Microorganism, characterized by the presence of a DNA sequence encoding a functional chaperone of a psychrophilic bacterium.
2. Microorganism according to claim 1, characterized in the DNA sequence encoding a functional chaperonin of a psychrophilic bacterium.
3. Microorganism according to claim 1, characterized in the DNA sequence encoding the chaperonin Cpn60 and/or Cpn 10 (SEQ ID No 1 and/or 2) of *Oleispira antarctica*.
4. Microorganism according to claim 1, characterized in the DNA sequence encoding a functional homolog of the chaperonin Cpn60 and/or Cpn10 of *Oleispira antarctica* (Seq ID Nr. 1 and/or 2) from a psychrophilic bacterium.
5. Microorganism according to claim 4, characterized in that the psychrophilic bacterium is selected from the group consisting of *Moraxella*, and *Alteromonas haloplanktis*.
6. Microorganism according to claim 1, characterized in the DNA sequence encoding a functional mutant of the chaperonin Cpn60 and/or Cpn 10 (Seq ID No 1 and/or 2) of *Oleispira antarctica*.
7. Microorganism according to claim 1, characterized in the DNA sequence encoding the stabilized single ring mutant chaperonin Glu461Ala/Ser463Ala/Val464Ala of Cpn60 (Seq ID No 11) or the mutant chaperonin Lys468Thr/Ser471Gly and/or Cpn 10.
8. Microorganism according to one of the preceding claims, which is selected among animal cell lines, plant cell lines, gram-positive or gram-negative bacteria, fungi and yeasts.
9. Microorganism according to one of the preceding claims, characterized in that the heterologous protein has enzymatic activity or hormonal activity in its native conformation.
10. Microorganism according to one of the preceding claims, characterized in that the DNA sequence encoding a functional chaperone is located chromosomally, extra-chromosomally, or mitochondrially, or in chloroplasts of plants.
11. Process for producing a protein by heterologous expression in a host microorganism containing a gene sequence encoding the heterologous protein, characterized in that a microorganism according to one of the preceding claims is used.
12. Process according to claim 11, characterized in that the host organism is cultivated at a temperature below 25 °C, preferably 4 to 15 °C.

13. Process according to claim 11 or 12, characterized in that the heterologous protein is selected from the group consisting of mammalian proteins, psychrophilic mammalian or bacterial proteins, mesophilic bacterial, fungal or yeast proteins, and mutant or fusion variants thereof.
14. Process for changing the conformation of denatured proteins into their native and/or active conformation, characterized by the step of contacting the denatured protein with a functional chaperone of a psychrophilic bacterium.
15. Process according to claim 14, characterized in that the chaperone is the chaperonin Cpn60 and/or Cpn 10 (Seq ID No 1 and/or 2) of *Oleispira antarctica* in presence of at least one nucleotide, preferably adenosine triphosphate.
16. Process according to claim 11, characterized in that the chaperone is a functional homolog of the chaperonin Cpn60 and/or Cpn 10 (Seq ID No 1 and/or 2) from a psychrophilic bacterium or a functional mutant of the chaperonin Cpn60 and/or Cpn 10 (Seq ID No 1 and/or 2) of *Oleispira antarctica*.
17. Process according to one of claims 11 to 16, characterized in that the contacting is performed extracellularly or *in vitro*.
18. Process according to claim 17, characterized in that the contacting uses at least one immobilized chaperone.
19. Plant, characterized in that it can grow at lower ambient temperatures due to the presence of a DNA sequence encoding a cold-active functional chaperone of a psychrophilic bacterium or plant.
20. Plant according to claim 19, characterized in the DNA sequence encoding a functional chaperonin selected from the group consisting of Cpn60 and/or Cpn 10 (SEQ ID No 1 and/or 2) of *Oleispira antarctica*, a functional homolog thereof, and the stabilized single ring mutant chaperonin Glu461Ala/Ser463Ala/Val464Ala of Cpn60 (Seq ID No 11).

Figure 1:**Amino acid sequences of Cpn60 and Cpn10:****SEQ ID No 1: Cpn10 (encoded by nucleotides pos. 458-751 of Figure 2):**

MKIRPLHDRVRRKEEETATAGGIILPGAAAEKPNQGVVISVGTGRILDNGSVQALA
VNEGDVVVFGKYSGQNTIDIDGEELLILNESDIYGVLEA

SEQ ID No 2: Cpn60 (encoded by nucleotides pos. 800-2446 of Figure 2):

MAAKDVLFGDSARAKMLVGVNILADAVRVTLGPKGRNVVIEKSFGAPIITKDGVSV
AREIELKDKFENMGAQMVKEVASQANDQAGDGTATTATVLAQAIISEGLKSVAAGMN
PMDLKRIGDKATAAVVAAIKEQAQPCLDTKAIAQVGTISANADETVGRLIAEAMEKV
GKEGVITVEEGKGLEDELVVEGMQFDRGYLSPYFINNQEKM TVEMENPLILLVDKK
IDNLQELLPILENVAKSGRPLLIVAEDVEGQALATLVVNNLRGTFKVA AVKAPGFGD
RRKAMLQDLAILTGGQVISEELGMSLETADPSSLGTASKVVIDKENTVIVDGAGTEAS
VNTRVDQIRAEIESSTSDYDIEKLQERVAKLAGGVA VIKVGAGSEMEMKEKKDRVD
DALHATRAAVEEGVVAGGGVALIRALSSVTVVGDNEDQNVGIALALRAMEAPIRQI
AGNAGAEGSVVVDKVKSGTGSFGFNASTGEYGDMLIAMGILDPKAVTRSSLQAAASI
AGLMITTEAMVADAPVEEGAGGMPDMGGMGGMGGMGMPGMM

Figure 2:**SEQ ID No 3: DNA coding for Cpn60 and Cpn10:**

Cpn10, pos. 458-751

Cpn60, pos. 800-2446

atcaaaaaatgcagcaaggacagattcctgcccaagaattagcagaagggttctgttagcactggccggcgctttattattaacgccgg
gtttgtcactgatgcgctgggtttacattactcgtccccgcgacgcgtaaagcggttggtccataaggtgattgcattattaccctc
gcatgatgactgcaagcagcttcaagcgcgaggtagtttcaggaaggctcggttaaagatgtacattcgacactgactcgcaaagca
gtcatgaaaaaatcacaattgaaggcgaatataccaaagacgataagtaggtatttttcggctagccggtgaaatcctagtaaaagccc

cgataaattaaccatctatttttcacagaggcaatttagcctttgtttaccttattgatcctaataacttgggatccaacagttggagagtctagc
aatgaaaatccgtccattacatgatcgtattgttgcgcgtaaagaagaagagaccgcaactgcgggtggtattatttacc
gggcgctgcggcagaaaaaccaaataaggtgttattctctgtgggtactggcgtattcttgataatggttcagtgaagcgtggc
ggttaacgaaggcgtgtgtcgttttggtaaatactcaggtcaaaatactatcgatatcgatggtgaagaattattgatttgaatga
aagtgatctacggcgttttagaagcttaattattacactcactttttttaacctaataaaattgaaggaaagatcatggctgctaaagacg
tattatttggatagcgcacgcgcaaaaatgttggtaggtgtaaacatttttagccgacgcagtaagagttaccttaggacctaa
aggtcgtaacgttgttatagaaaaatcatttgggtgcaccgatcatcacaaagatggtgtttctgttgcgcgtgaaatcgaattgaaagaca
aattcgaaaacatgggcgcacagatggttaaggaagttgcttctcaagccaacgaccaagccggtgacggcacaacgacagcgact
gtactagcacaggcgattatcagcgaaggcttgaaatctgttgcggctggcatgaatccaatggatcttaaacgtggtattgataaagcta
cggctgctgttgttgcgcgccaataaagaacaagctcagccttgcttgatacaaaagcaatcgctcaggtagggaacaatctctgccaatg
ccgatgaaacggttggctgttaattgctgaagcgatggaaaaagtcggtaaagaaggtgtgattaccgttgaagaaggcaaaggcctt
gaagacgagcttgatgtttagaaggcatgcagttcgatcgcggttacttgtctccgtacttcatcaacaaccaagaaaaaatgaccgta
gaaatggaaaatccattaattctatttgggtgataagaaaattgataacctcaagagctgttgccaattcttgaaaacgtcgctaaatcaggt
cgtccattattgatcgttgcgaagatgttgaaggccaagcactagcaacattggtagtaacaacttgcgcggcacattcaaggttgc
agcgggttaaagccccgtgtttggcgatcgtcgtaaagcgatgttgcaagatcttgccatcttgacgggtggtcaggttattctgaagag
ctagggatgtcttagaaactgcggatccttcttgggtacggcaagcaaggttgtatcgataaagaaaacaccgtgattgtga
tggcgcaggtactgaagcaagcgtaatactcgtgttgaccagatccgtgctgaaatcgaaagctcgacttctgattacgacatcgaaaa
gttacaagaacgcgttgctaagcttgcgggcggttgcggtgattaagggttgcgggttctgaaatggaaatgaaagagaagaaa
gaccgtgttgacgatgcacttcatgcaactcgcgacgggtgaagaaggtgttgcgggtggtggtgttgccttgattcgcgcactct
cttcagtaaccgttgttgggtgataacgaagatcaaaacgtcgggtattgcattggcacttctgcgatggaagctcctatccgtcaaatcgc
gggtaacgcaggtgctgaagggtcagtggttgtgataaagtgaatctggcacaggttagcttgggtttaaaccgacacaggtgagt
atggcgatatgattgcgatgggtatttttagaccctgcaaaagtcacgcgttcatctctacaagccgcggcgtctatcgacaggttgcgat
cacaaccgaagccatggttgcggatgcgcctgttgaagaaggcgctggtggtatgcctgatatgggcggcatgggtggaatgggcg
gtatgcctggcatgatgtaatcactttgtgattcattgtcctgatctgcttaccgtgtaaaaagatcaggctcaaggctgtctctataaaaag
ccgtatcttgcgatgagtggttcttctgctgaaaacgacattcttgagtgcggttttttgatttgggtcataaaattcagaatattgtgaatt
ttatgtaactagctggcctataatgttgagttcctctgggtggcatgatctcatggtacttcaagcctgattcactgcg
gctttaaagtaaaataataacgcaacgtagaaacataataagcgatggcattaatgaagacggctgcatttaattcagatc

Figure 3:

SEQ ID No 4: Amino acid sequence of esterase cloned from *Oleispira antarctica* (EstRB8):

EstRB8 (encoded by nucleotides 1145 to 2143 Frame 2 of Figur 4) 333 aa

MKNTLKSSSRFSLKQLGTGALISSLFFGGCTTTQQDNLYTGVM SLARDSAGLEVKTA
 SAGDVNLT YMERQGSDKDNAESVILLHGFSADKDNWILFTKEFDEK YHVIAVDLAG
 HGDSEQLLT TDYGLIKQAERLDIFLSGLGVNSFHIAGNSMGG AISAIYSLSHPEKVKSL
 TLIDAAGVDG DTESEYYKVLAEGKNPLIATDEASFEYRMGFTMTQPPFLPWPLRPSLL
 RKTLARAEINN KIFSDMLKTKERLGMTNFQQKIEVKMAQHPLPTLIMWGKEDRVLD
 VSAAAAFKKIIPQATVHIFPEVGHLP MVEIPSESAKVYEEFLSSIK

Figure 4:

SEQ ID No 5: DNA fragment from plasmid pBK1Est coding for esterase of *Oleispira antarctica* (EstRB8):

Nucleotide positions 1-100 correspond to reverse complement of positions 1196-1121 and 3799-3939 correspond to reverse complement of 1043-952 of pBK-CMV vector (Stratagene).

Positions 101-105 are *Bam*HI – *Sau*3A1 fusion and positions 3795-3798 are *Sau*3A1-*Bam*HI-fusion.

acaggaaacagctatgaccttgattacgccaagctcgaaattaaccctcactaaagggaacaaaagctggagctcgcgcgcctgcag
 gtcgacactagtggatcaacggcggtcatggtactggctgagttcagcgtcataatgccgatgcgatactggccgcatgactgagtact
 tcttctgctagcaccgatttttctaatagcgcagcttcttttattctgaacgggcaactgatgtagttttttactaaccggcttttaggcatgg
 taaactcttcgatattcaaaattattactgttcattacaatcatagtagcaggctagaggcccaaaattgcagctgatattcacctttattattc
 taagcattattacactcatcgcggtgttattaattgtgctaaataaaaaatacccgtagcggaaaaattcagcaaataagccaaagaaaacga
 ttggcaataccaagaattcatcgattttgatgatgacattaagcaggcaaactttggcctattaaactacagtcaaaatgcaatttttagacat
 ctcatcaagcaactgacgaacactatggcttagcgtttaagacctttgactgtcgagcgtagaaccttcaggtattcacaatagcagtct
 tattttatttaccctcgcactaaagactgaattcaataacctacacatttgcttaagtcgacatattcaagataaagatgccttcactgacatca
 gtcaccaacaatcaatcaaacaccaataccaatcgcaaaaactcataaaactagccgatcaccaaattccaaaagcgttcaaaaatgaa
 acgagcacgtcacacaaaatcaattatacgctaacgaaccagggtcaaacttatcggtttttgagcacgtttgtccactaatgaaagaga
 aaagtcgttaattcactggcttttggcgtatccgcaccttcacatagaaattagtaattggcatgctactggcctttaaagaatcagttaatt
 gaagaaacctcgcttatctcagccattaccgctgtagccgaatttgcgcttatcctcagccatgattaaactgacgccaattaatataagac
 atactaattaataactcccttaattgagaagaataatgaaaaacacactcaaatacctcatcacgttttagtctgaaacaactcggcaccggc
 gctctgattatctccagtttgttcttcggtgggtgcaccacaacacaacaagataattatacacaggggttatgtctcttgcgagagacagc
 gctggcctagaagttaaaacagcctctgccggtgacgtcaatcttacttatatggaacgccaaggcagtgacaaagataatgccgaaag

cggtattttattacacggtttctctgctgataaagataactggattcttttaccaaagaattcgaatgaaaaatcatgttatcgctgtcgattta
gcgggacatggcgattcagaacaattattaacgactgattacgggtctataaaacaagccgagcggttagatatcttcttatctggcttagg
ggtaactcatttcacatcgccggttaattcaatggggggggctatcagcgcaatctacagtttgagtcacccagagaaagttaaaagtctt
acattgatcgatgcagcaggtgtcgatggcgatactgaaagcgaatactacaaagtttggcagaaggtaagaatcctttaattgcaact
gatgaagcaagtttgaataccgcatgggttccacatgactcagcctccttctaccttggccactaagaccttcttattacgtaaaacg
ctagcccggtgccgagatcaataacaaaatttttccgatatgctgaaaaccaaagaacgttaggaatgactaacttcaacagaaaattg
aagtgaaaatgggtcaacatccattgccaacactgattatgtggggcaaagaagatcgcggttcttgacgtatccgcagcagcggccttc
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gaagagttttgtcctctattaaataagagcacataatcatgactgacttataaacagccaagcatttaaaatgcttgggtgtttatttaattg
ccaaattattcaacgaccaagctctgcggtaaaatcgagtggttcttgtttcatcaacagcaacaacgtgaaatacccgtaatcg
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cgacaatggtacctgcgggaacaggatgcttaaaatcgattcgatcactgctgacgggtacgatgcttctgcagaaaaacgagtcgct
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aatagtggttttgatacgcgcttctgctgcgcaataatatcttctctgctaagagttgcggatggcatacataaactcgcttgattaagatta
ataataaatagttaacagtatattgaactgagggtctgaagaactctaataacctctgaagaacttgaggccgctagagagaaaagacca
gtgataatatttcatcttgccatgagagcttatcatgaaagcctgtgcttaaaatcaatcattatatttcatctttaattgaaataataccaat
atatttcataataatttcacactacccttatctcactagacttcccgcgcataggcgcaacaatcaacgcaagttcacaataaagcggctc
gctgcaacacatgccctagcgtctaaagtagcacgcacaacactggccagtcgtactagcccccttgcgattcgtgcagacgagcaac
aagcgctattaaacttacctaaatttctaaccaccaccattgggtctttccacaaactcaaaaaactcgtaaatccgcttgcaatttaaacg
cgatgacatagatctaactgattatcaaaccgcattcaagcgctcattaaaaacgcaccactggcaagaagttctacctgcactgacca
atatgcaagcggcggcggaagagctgccttgatcgatcaagaagaaggagcagcaaaagaggaaaacaatcaaaaagaggaga
gcaatcaataaaaacgagttattgaggattttaattttaaacaggtatattaataccctctctcgtagtaaacatgactgtatttacaaa
aaataaatagaggtataccatgtcaaacatctgggttgaagtaccaaagattgaagtattaaaccgtcaaatggaaaatactgcctgcagc
aacttaggcattcaaattacagaaattggcgatgattatcactggcacaatgccagcagatgcacgtaccttcagccaatgggactg
attcatggcgggtcaaattgtattgctggcagaaacactgggcagcatggcagctaactgctgtatttaattgtctcaagaatattgtgttg
ccaagaaattaacgccaaccacatacgcggtgttcgttcggcatagtactggcacagcaacgctagtacacaaaggaagaacctc
ccagatttgggaaattcgcatcgtaacgatccaaagaattcaaaaagcttctcgagagtacttctagagcggccgcgggcccatcgatt
ttccaccgggtgggtaccaggttaagtgtaccaattcgccctatagttagtgcgtattacaattcactggccgtcgtttac

Figure 5:

Amino acid sequences expressed from vector pBK1CpnEst: - the co-expression of fragments encoding native chaperonins with the esterase gene (EstRB8), all from *Oleispira antarctica*

SEQ ID No 6: cpn10 (nucleotides 113 to 403: Frame 2 of Figure 6) 97 aa:

MKIRPLHDRIVVRRKEEETATAGGILPGAAAEKPNQGVVISVGTGRILDNGSVQALA
VNEGDVVVFGKYSGQNTIDIDGEELLILNESDIYGVLEA

SEQ ID No 7: cpn60 (nucleotides 455 to 2098: Frame 2 of Figure 6) 548 aa:

MAAKDVLFGDSARAKMLVGVNILADAVRVTLGPKGRNVVIEKSFGAPIITKDGVS
AREIELKDKFENMGAQMVKEVASQANDQAGDGTTTATVLAQAISEGLKSVAAGMN
PMDLKRGRIDKATAAVVAAIKEQAQPCLDTKAIAQVGTISANADETVGRLIAEAMEKV
GKEGVITVEEGKGLEDELDDVEGMQFDRGYLSPYFINNQEKMTVEMENPLILLVDKK
IDNLQELLPILENVAKSGRPLLIVAEDVEGQALATLVVNNLRGTFKVAAVKAPGFGD
RRKAMLQDLAILTGGQVISEELGMSLETADPSSLGTASKVVIDKENTVIVDGAGTEAS
VNTRVDQIRAEIESSTSDYDIEKLQERVAKLAGGVAVIKVGAGSEMEMKEKKDRVD
DALHATRAAVEEGVVAGGGVALIRALSSVTVVGDNEDQNVGLALALRAMEAPIRQI
AGNAGAEGSVVVDKVKSGTGSFGFNASTGEYGDMIAMGILDPKAVTRSSLQAAASI
AGLMITTEAMVADAPVEEGAGGMPDMGGMGGMGGMGGMPGMM

SEQ ID No 8: estRB8 (nucleotides 2579 to 3577: Frame 2 of Figure 6) 333 aa:

MKN TLKSSSRFSLKQLGTGALISSLFFGGCTTTQQDNLYTGVM SLARDSAGLEVKTA
SAGDVNLTYMERQGS DKN AESVILLHGFSADKDNWILFTKEFDEKYHVIAVDLAG
HGDSEQLLT TDYGLIKQAERLDIFLSGLGVNSFHLAGNSMGG AISAIYSLSHPEKVKSL
TLIDAAGVDGDTESEYYKVLAEGKNPLIATDEASFEYRMGFTMTQPPFLPWPLRPSLL
RKTLARAEINN KIFSDMLKTKERLGMTNFQQKIEVKMAQHPLPTLIMWGKEDRVLD
VSAAA AFKKIIPQATVHIFPEVGHLPMVEIPSESAKVYEEFLSSIK

Figure 6:

SEQ ID No 9: pBK1CpnEst: - the fusion of native chaperonine-coding fragments with esterase of *Oleispira antarctica* (EstRB8)

The DNA fragment coding for Cpn10 and Cpn60 is flanked by *SacI* site (pos. 69-75) and *SalI* site (encoded by pos. 2138-2143 of Figure 7):

Nucleotide positions 1-75 correspond to reverse complement of positions 1196-1121 and positions 5233-5273 correspond to reverse complement of 1043-952 of pBK-CMV vector (Stratagene)

Small letters – the Cpn10-Cpn60 encoding fragment,

Capital italics – fragments of vector pBK-CMV

Capital letters – fragment coding for EstRB8 from plasmid pBK1Est

ACAGGAAACAGCTATGACCTTGATTACGCCAAGCTCGAAATTAACCCTCACTAAAGGGA
*ACAAAAGCTGGAGCTC*ctaatactgggatccaacagttggagagtctagcaaatgaaatccgtccattacatgatcgtatt
gttgttcgccgtaaagaagaagagaccgcaactgcgggtggtattatccggcgctgcggcagaaaaacaaatcaagggtgtgt
tatctctgtgggtactggccgtattcttgataatggttcagtgcaagcgctggcggttaacgaaggcgatgtgtcgttttgtaaatactc
aggtcaaaatactatcgatatcgatggtgaagaattattgattttgaatgaaagtatactacggcgtttagaagcttaattattacactca
ctttttatftaacctacaaaatttaaggaaagatcatggctgctaaagacgtattatttggtgatagcgcacgcgcaaaaatgttggttaggt
gtaaacatttttagccgacgcagtaagagttaccttaggacctaaaggctgtaacgttggttatagaaaaatcatttggtgcaccgatcatcac
caaagatggtgtttctgttcgcgctgaaatcgaattgaaagacaaattcgaaaacatgggcgcacagatggttaaggaaagtgcttctca
agccaacgaccaagccggtgacggcacaacgacagcgactgtactagcacaggcgattatcagcgaaggcttgaaatctgttgccg
ctggcatgaatccaatggatcttaaacgtggtattgataaagctacggctgctgttggtgcccattaaagaacaagctcagccttgcttg
gatacaaaagcaatcgctcaggtagggaatctctgccaatgccgatgaaacgggttggtcgtttaattgctgaagcgatggaaaaagt
cggtaaagaagggtgtgattaccggtgaagaaggcaaaggccttgaagacgagcttgatgttgtagaaggcatgcagttcgatcgcggtt
actgtctccgtacttcatcaacaaccaagaaaaatgaccgtagaaatggaaaatccattaatctattggtgataagaaaattgataac
cttcaagagctgttgccaattctgaaaacgtcgctaaatcaggctgtccattattgatcgttgctgaagatgttgaggccaagcactagc
aacattggttagtaaacacttgccgcgacattcaagggtgcagcggttaaagcccctggtttggcgatcgtcgtaaagcgatgttgca
agatcttgccatcttgacgggtggtcaggttattctgaagagctagggatgtcttagaaactgcggatccttcttcttggttacggcaa
gcaaggttggtatcgataaagaaaacaccgtgattgttgatggcgacaggtactgaagcaagcggttaatactcgtgttgaccagatccgtg
cigaaatcgaaagctcgactctgattacgacatcgaaaagttacaagaacgcgttgctaagcttgccggcggttgccgtgattaag

gttggtgcgggttctgaaatggaaatgaaagagaagaaagaccgtgttgacgatgcacttcatgcaactcgcgacggttgaagaag
gtgtgttgcgggtggtggtgttgctttgattcgcgactctcttcagtaaccgttgttggtgataacgaagatcaaaacgtcggattgcat
tggcacttcgtgcgatggaagctcctatccgtcaaatcgcggttaacgcaggtgctgaagggtcagtggtgttgataaagtgaatctg
gcacaggtagctttggttttaacgccagcacaggtgagtatggcgatatgattgcgatgggtatttttagaccctgcaaaagtcacgcgttc
atctctacaagccgcggtctatcgaggtttgatgatcacaaccgaagccatggttgcggatgcgcctgttgaagaaggcgctggtg
gtatgcctgatatgggcggtcatgggtggaatgggcggtatgcctggcatgatgtaatcactttgtgattcattgtcctgatctgcttaccgt
GTCGACATATTCAAGATAAAGATGCCTTCACTGACATCAGTCACCAACAATCAAT
CAAACACCAATACCAATCGCAAAAACCTCATAAACTAGCCGATCACCAAAATCCC
AAAAGCGTTCAAAAATGAAACGAGCACGTCACACAAAATCAATTTATACGCTAA
CGAACCAGGTCAAACCTTATCGTTTTTTTTGAGCACGTTTGTTCCTACTAATGAAAGA
GAAAAGTCGTTAATTCCTGGCTTTTGGCGTATCCGCACCTTCACATAGAAATTA
GTAATGGCATGCTACTGGCCTTTAAAAAGAATCAGTTAATTGAAGAAACCTCGCT
TATCTCAGCCATTACCGCTGTAGCCGAATTTGCGCTTATCCTCAGCCATGATTAAA
CTGACGCCAATTAATATAAGACATACTAATTAATAACTCCCTTAATTGAGAAGAA
TAATGAAAAACACACTCAAATCCTCATCACGTTTTAGTCTGAAACAACCTCGGCAC
CGGCGCTCTGATTATCTCCAGTTTGTTCCTTCGGTGGTTGCACCACAACACAACAAG
ATAATTTATACACAGGGGTTATGTCTCTTGCGAGAGACAGCGCTGGCCTAGAAGT
TAAACAGCCTCTGCCGGTGACGTCAATCTTACTTATATGGAACGCCAAGGCAGT
GACAAAGATAATGCCGAAAGCGTTATTTTATTACACGGTTTCTCTGCTGATAAAG
ATAACTGGATTCTTTTTTACCAAAGAATTCGATGAAAAATATCATGTTATCGCTGTC
GATTTAGCGGGACATGGCGATTTCAGAACAAATTATTAACGACTGATTACGGTCTCA
TAAACAAGCCGAGCGTTTAGATATCTTCTTATCTGGCTTAGGGGTAACTCATTT
CACATCGCCGGTAATTCAATGGGGGGGGCTATCAGCGCAATCTACAGTTTGAGTC
ACCCAGAGAAAGTTAAAAGTCTTACATTGATCGATGCAGCAGGTGTCGATGGCG
ATACTGAAAGCGAATACTACAAAGTTTTGGCAGAAGGTAAAGAATCCTTTAATTGC
AACTGATGAAGCAAGTTTTTGAATACCGCATGGGTTTCACCATGACTCAGCCTCCT
TTCCTACCTTGGCCACTAAGACCTTCTTTATTACGTAAAACGCTAGCCCGTGCCGA
GATCAATAACAAAATTTTTTCCGATATGCTGAAAACCAAAGAACGTTTAGGAATG
ACTAACTTTCAACAGAAAATTGAAGTGAAAATGGCTCAACATCCATTGCCAACAC
TGATTATGTGGGGCAAAGAAGATCGCGTTCTTGACGTATCCGCAGCAGCGGCCTT
CAAAAAAATAATTCCACAAGCAACTGTTTCATATTTTTTCTGAAGTAGGCCACCTA
CCTATGGTAGAAATTCCTAGTGAAAGCGCTAAAGTTTATGAAGAGTTTTTGTCTT
CTATTAAATAAGAGCACATAATCATGACTGACTTATAAACAGCCAAGCATTTAAA
ATGCTTGGCTGTTTATTTTAATGGCCAAATTATTCAACGACCAAGCTCTGCGGTAA

AATCGCAGTGGGTTTCTTGTTTTTCATCAACAGCAACAAACGTGAAATACCCCGTA
ATCGCATTTTTCTGATTATCAAAATACATACTTTCCACCAGCATATTAAC TTCAAC
TTTTAAACTCGTCCGCCCTACCTCTATAACACTGGCAGTCAATTCGACAATGGTAC
CTGCGGGAACAGGATGCTTAAAATCGATTTCGATCACTGCTGACGGTTACGATGCT
TTGTCGAGAAAAACGAGTCGCTGCAATAAAAGAAACCTCATCCATCCACTGCATT
GCAGTGCCACCGAATAACGTATCATGATGATTTGTTGTCTCTGGAAATACCGCTTT
AGAAATAGTGGTTTTTTGATACGCGCTTTTCGCTGCGCAATAATATCTTCTCTGCTAA
GAGTTGCGGATGGCATAATAAACTCGCTTGATTAAGATTAATAATAAATAGTTA
ACAGTATATTGAACTGAGGGTCTGAAGAACTCTAATACCTCTGAAGAACTTTGAG
GCCGCTAGAGAGAAAAGACCAGTGATAATATTTTCATCTTGCCATGAGAGCTTATC
ATGAAAGCCTGTGCTTAAAATCAATCATTATATTTATTCATCTTTAATTGAAATAA
TACCAATATATTTTCATATATAATTTTCACACTACCCTTATCTCACTAGACTTCCCGC
GCATAGGCGCAAACAATCAACGCAAGTTCACAATAAAGCGGTTTCGCTGCAACAC
ATGCCCTAGCGTCTAAAGTAGCACGCACAACACTGGCCAGTCGTACTAGCCCCTT
TGCGATTTCGTGCAGACGAGCAACAAGCGCTATTAAACTTACCTAAATTTCTAACC
ACCACCATTGGTTCTTTTCCACAAACTCAAAAAACTCGTCAAATCCGCTTGCAATT
TAAACGCGATGACATAGATCTAATCGATTATCAAACCCGCATTCAAGCGCTCATT
AAAAACGCACCACTGGCAAGAAGTTCTACCTGCACTGACCAATATGCAAGCGGC
GGCGGAAGAGCTGCCTTTGATCGATCAAGAAGAAGGGAGCAGCAAAGAGGAAA
ACAATCAAAAAGAGGAGAGCAATCAAATAAAAACGAGTTATTGAGGATTTTAAT
TTTAAACAGGTATATTAATACCCTCTCTCGTAGTAAACAATGACTGTATTTACAC
AAAAATAAATAGAGGTATACCATGTCAAACATCTGGTTTGAAGTACCAAAGATTG
AAGTATTAAACCGTCAAATGGAAAATACTGCCTGCAGCAACTTAGGCATTCAAAT
TACAGAAATTGGCGATGATTATATCACTGGCACAATGCCAGCAGATGCACGTACC
TTCCAGCCAATGGGACTGATTCATGGCGGCTCAAATGTATTGCTGGCAGAAACAC
TGGGCAGCATGGCAGCTAACTGCTGTATTAATTTGTCTCAAGAATATTGTGTTGG
CCAAGAAATTAACGCCAACCACATACGCGGTGTTTCGTTCCGGCATAGTGACTGGC
ACAGCAACGCTAGTACACAAAGGAAGAACCTCCCAGATTTGGGAAATTCGCATC
GTTAACGATCCAAAGAATTCAAAAAGCTTCTCGAGAGTACTTCTAGAGCGGCCGCGGG
CCCATCGATTTTCCACCCGGGTGGGGTACCAGGTAAGTGTACCCAATTCGCCCTATAGT
GAGTCGTATTACAATTCCTGGCCGTCGTTTTAC

Figure 7:

Amino acid sequences expressed from vector pBK1CpnSREst: - the co-expression of the stabilized single ring mutant chaperonin with the esterase gene (EstRB8) from *Oleispira antarctica* (cpn10::stabilized single ring mutant Glu461Ala/Ser463Ala/Val464Ala::est)

SEQ ID No 10: cpn10 (nucleotides 113 to 403: Frame 2 of Figure 8) 97 aa:

MKIRPLHDRVVRRKEEETATAGGILPGAAAEKPNQGVVISVGTGRILDNGSVQALA
VNEGDVVVFGKYSGQNTIDIDGEELLILNESDIYGVLEA

Below – *Capital bold letters* are the mutations introduced

SEQ ID No 11: stabilized single ring mutant of cpn60 (nucleotides 455 to 2098: Frame 2 of Figure 8) 548 aa:

MAAKDVLFGDSARAKMLVGVN~~L~~ADAVR~~V~~TLGPKGRNVVIEKSFGAPIITKDGVSV
AREIELKDKFENMGAQM~~V~~KEVASQANDQAGDGTTTATVLAQAIISEGLKSVAAGMN
PMDLKR~~G~~IDKATAAVVAAI~~K~~EQAQPCLDTKAIAQVGTISANADET~~V~~GRLIAEAMEKV
GKEGVITVEEGKGLEDEL~~D~~VVEGMQFDRGYLSPYFINNQE~~K~~MTVEMENPLILLVDKK
IDNLQELLPILENVAKSGRPLLVAEDVEGQALATLVVNNLRGTFKVA~~A~~VKAPGFGD
RRKAMLQDLAILTGGQVISEELGMSLETADPSSLGTASKVVIDKENTVIVDGAGTEAS
VNTRVDQIRAEIESSTSDYDIEKLQERVAKLAGGVA~~V~~IKVGAGSEMEMKEKKDRVD
DALHATRAAVEEGVVAGGGVALIRALSSVTVVGDNEDQNVGIALALRAMEAPIRQI
AGNAGA~~A~~G~~A~~AVVDKVKSGTGSFGFNASTGEYGDMIAMGILDPK~~V~~TRSSLQAAASI
AGLMITTEAMVADAPVEEGAGGMPDMGGMGGMGGMGGMPGMM

SEQ ID No 12: EstRB8 (nucleotides 2579 to 3577: Frame 2 of Figure 8) 333 aa:

MKNTLKSSSRFSLKQLGTGALI~~SS~~LFFGGCTTTQQDNLYTGVM~~S~~LARDSAGLEVKTA
SAGDVNLTYMERQGS~~D~~KDNAESVILLHGFSADKDNWILFTKEFDEKYHVIAVDLAG
HGDSEQLLTDDYGLIKQAERLDIFLSGLGVNSFHLAGNSMGG~~A~~ISAIYSLSHPEKVKSL
TLIDAAGVDGDTESEYYK~~V~~LAEGKNPLIATDEASFEYRMGFTMTQPPFLPWPLRPSLL

RKTLARAEINNKFSDMLKTKERLGMTNFQQKIEVKMAQHPLPTLIMWGKEDRVLD
VSAAAFKKIPQATVHIFPEVGHLPMVEIPSESAKVYEEFLSSIK

Figure 8:

SEQ ID No 13: DNA sequence of vector pBK1CpnSREst: the expression cassette for the co-expression of the stabilized single ring mutant chaperonin with the esterase gene (EstRB8) from *Oleispira antarctica* (cpn10::stabilized single ring mutant Glu461Ala/Ser463Ala/Val464Ala::est)

Nucleotide positions 1-75 correspond to reverse complement of positions 1196-1121 and positions 5233-5273 correspond to reverse complement of 1043-952 of pBK-CMV vector (Stratagene)

DNA fragment coding for Cpn10 and Cpn60 is flanked by *SacI* site (pos. 69-75) and *SalI* site (pos. 2138-2143).

In the DNA sequence:

Small letters – the Cpn10-Cpn60 coding fragment,

Capital italics – fragments of vector

Capital letters – fragment coding for EstRB8 from plasmid pBK1Est

Capital bold letters = introduced mutations

ACAGGAAACAGCTATGACCTTGATTACGCCAAGCTCGAAATTAACCCTCACTAAAGGGA
*ACAAAAGCTGGAGCTC*ctaatacttgggatccaacagttggagagtctagcaaatgaaaatccgtccattacatgatcgtatt
gttggtcgccgtaaagaagaagagaccgcaactgcgggtgttattttaccgggcgctgcggcagaaaaacaaatcaaggtgtgt
tatctctgtgggtactggccgtattcttgataatggttcagtgcaagcgctggcggtaacgaaggcgatgttgcgttttggtaaatactc
aggtcaaaatactatcgatatcgatggtgaagaattattgattttgaatgaaagtatatctacggcgttttagaagcttaattattacactca
ctttttatttaacctacaaaatttaaggaaagatcatggctgctaagacgtattatttggtgatagcgcacgcgcaaaaatgttggttaggt
gtaaacatttttagccgacgcagtaagagttaccttaggacctaaaggctgtaacgttggtatagaaaaatcatttggtgcaccgatcatcac
caaagatggtgtttctgttgcgcgtgaaatcgaattgaaagacaaattcgaaaacatgggcgcacagatggttaagggaagttgcttctca
agccaacgaccaagccggtgacggcacaacgacagcgactgtactagcacaggcgattatcagcgaaggcttgaaatctgttcgg
ctggcaigaatccaatggatcttaaacgttggtattgataaagctacggctgctgttggtgccgcatgaagaacaagctcagccttgcttg

gatacaaaagcaatcgctcaggtagggacaatctctgccaatgccgatgaaacgggtggctgttaattgctgaagcgatggaaaaagt
cggtaaagaagggtgtgattaccgttgaagaaggcaaaggccttgaagacgagcttgatgtttagaaggcatgcagttcgatcgcggtt
acttgtctccgtacttcatcaacaaccaagaaaaatgaccgtagaaatggaaaatccattaattctattgggtgataagaaaattgataac
cttcaagagctgttgccaattcttgaaaacgtcgctaaatcaggtcgccattattgatcgttgctgaagatgttgaaggccaagcactagc
aacattggtagtaaacaacttgcgcggcacattcaagggtgcagcgggttaaagccccctggtttggcgatcgtcgtaaagcgatgttgca
agatcttgccatcttgacgggtgggtcaggttatttctgaagagctagggtatgtctttagaaaactgcggatccttcttcttgggtacggcaa
gcaagggtgttatcgataaagaaaacaccgtgattgttgatggcgcaggtactgaagcaagcggttaatactcgtgttgaccagatccgtg
ctgaaatcgaaagctcgacttctgattacgacatcgaaaagttacaagaacgcgttgctaagcttgcgggcggcggttgccgtgattaag
gttgggtgcgggttctgaaatggaaatgaaagagaagaaagaccgtgttgacgatgcacttcatgcaactcgcgcagcgggtgaagaag
gtgtgttgcggggtgggtgtgtgttcttgattcgcgcactctcttcagtaaccgttgggtgataacgaagatcaaaacgtcggtattgcat
tggcacttcgtcgatggaagctcctatccgtcaaatcgcgggtaacgcaggtgctgCagggGcagCggttgttgataaagtgaat
ctggcacaggtagctttggtttaacgccagcacaggtgagtatggcgatatgattgcgatgggtatttttagaccctgcaaaagtcacgc
gttcatctctacaagccgcggcgtctatcgaggtttgatgatcacaaccgaagccatggttgcgatgcgcctgttgaagaaggcgct
gggtgttatgcctgatatgggcggcatgggtggaatgggcgggtatgcctggcatgatgtaatcactttgtgattcattgtcctgatctgctta
ccgtGTCGACATATTCAAGATAAAGATGCCTTCACTGACATCAGTCACCAACAATC
AATCAAACACCAATACCAATCGCAAAAACCTCATAAACTAGCCGATCACCAAAT
CCCAAAAGCGTTCAAAAATGAAACGAGCACGTCACACAAAATCAATTTATACGC
TAACGAACCAGGTCAAACCTTATCGTTTTTTTGTGACGCTTTGTTCCACTAATGAAA
GAGAAAAGTCGTTAATTCCTGGCTTTTGGCGTATCCGCACCTTCACATAGAAAT
TAGTAATGGCATGCTACTGGCCTTTAAAAAGAATCAGTTAATTGAAGAAACCTCG
CTTATCTCAGCCATTACCGCTGTAGCCGAATTTGCGCTTATCCTCAGCCATGATTA
AACTGACGCCAATTAATATAAGACATACTAATTAATAACTCCCTTAATTGAGAAG
AATAATGAAAAACACACTCAAATCCTCATCACGTTTTAGTCTGAAACAACCTCGGC
ACCGGCGCTCTGATTATCTCCAGTTTGTCTTTCGGTGGTTGCACCACAACACAACA
AGATAATTTATACACAGGGGTATGTCTCTTGCGAGAGACAGCGCTGGCCTAGAA
GTTAAAACAGCCTCTGCCGGTGACGTCAATCTTACTTATATGGAACGCCAAGGCA
GTGACAAAGATAATGCCGAAAGCGTTATTTTATTACACGGTTTCTCTGCTGATAA
AGATAACTGGATTCTTTTTACCAAAGAATTCGATGAAAAATATCATGTTATCGCT
GTCGATTTAGCGGGACATGGCGATTGAGAACAATTATTAACGACTGATTACGGTC
TCATAAAACAAGCCGAGCGTTTAGATATCTTCTTATCTGGCTTAGGGGTAACTC
ATTTACATCGCCGGTAATTCAATGGGGGGGGCTATCAGCGCAATCTACAGTTTG
AGTCACCCAGAGAAAGTTAAAAGTCTTACATTGATCGATGCAGCAGGTGTCGATG
GCGATACTGAAAGCGAATACTACAAAGTTTTGGCAGAAGGTAAGAATCCTTTAAT
TGCAACTGATGAAGCAAGTTTTGAATACCGCATGGGTTTCACCATGACTCAGCCT

CCTTTCCTACCTTGGCCACTAAGACCTTCTTTATTACGTAAAACGCTAGCCCGTGC
CGAGATCAATAACAAAATTTTTTCCGATATGCTGAAAACCAAAGAACGTTTAGGA
ATGACTAACTTTCAACAGAAAATTGAAGTGAAAATGGCTCAACATCCATTGCCAA
CACTGATTATGTGGGGCAAAGAAGATCGCGTTCTTGACGTATCCGCAGCAGCGGC
CTTCAAAAAAATAATTCCACAAGCAACTGTTTCATATTTTTCTGAAGTAGGCCAC
CTACCTATGGTAGAAATTCCTAGTGAAAGCGCTAAAGTTTATGAAGAGTTTTTGT
CCTCTATTAAATAAGAGCACATAATCATGACTGACTTATAAACAGCCAAGCATTT
AAAATGCTTGGCTGTTTATTTTAATGGCCAAATTATTCAACGACCAAGCTCTGCG
GTAAAATCGCAGTGGGTTTCTTGTTTTTCATCAACAGCAACAAACGTGAAATACCC
CGTAATCGCATTTTTCTGATTATCAAAAATACATACTTTCCACCAGCATATTAECTT
CAACTTTTAAACTCGTCCGCCCTACCTCTATAACACTGGCAGTCAATTCGACAATG
GTACCTGCGGGAACAGGATGCTTAAAATCGATTTCGATCACTGCTGACGGTTACGA
TGCTTTGTCTGAGAAAAACGAGTCGCTGCAATAAAAGAAACCTCATCCATCCACTG
CATTGCAGTGCCACCGAATAACGTATCATGATGATTTGTTGTCTCTGGAAATACC
GCTTTAGAAATAGTGGTTTTTGATACGCGCTTTCGCTGCGCAATAATATCTTCTCT
GCTAAGAGTTGCGGATGGCATACTAAACTCGCTTGATTAAGATTAATAATAAAT
AGTTAACAGTATATTGAACTGAGGGTCTGAAGAACTCTAATACCTCTGAAGAACT
TTGAGGCCGCTAGAGAGAAAAGACCAGTGATAATATTTTCATCTTGCCATGAGAGC
TTATCATGAAAGCCTGTGCTTAAAATCAATCATTATATTTATTCATCTTTAATTGA
AATAATACCAATATATTTTCATATATAATTTACACTACCCTTATCTCACTAGACTT
CCCGCGCATAGGCGCAAACAATCAACGCAAGTTCACAATAAAGCGGTTCGCTGC
AACACATGCCCTAGCGTCTAAAGTAGCACGCACAACACTGGCCAGTCGTACTAGC
CCCTTTGCGATTTCGTGCAGACGAGCAACAAGCGCTATTAAACTTACCTAAATTTT
TAACCACCACCATTTGGTTCTTTTCCACAAACTCAAAAAACTCGTCAAATCCGCTTG
CAATTTAAACGCGATGACATAGATCTAATCGATTATCAAACCCGCATTCAAGCGC
TCATTAAAAACGCACCACTGGCAAGAAGTTCTACCTGCACTGACCAATATGCAAG
CGGCGGCGGAAGAGCTGCCTTTGATCGATCAAGAAGAAGGGAGCAGCAAAGAGG
AAAACAATCAAAAAGAGGAGAGCAATCAAATAAAAACGAGTTATTGAGGATTTT
AATTTTAAACAGGTATATTAATACCCTCTCTCGTAGTAAACAATGACTGTATTTA
CACAAAAATAAATAGAGGTATACCATGTCAAACATCTGGTTTGAAGTACCAAAG
ATTGAAGTATTAAACCGTCAAATGGAAAATACTGCCTGCAGCAACTTAGGCATTC
AAATTACAGAAATTGGCGATGATTATATCACTGGCACAATGCCAGCAGATGCACG
TACCTTCCAGCCAATGGGACTGATTCATGGCGGCTCAAATGTATTGCTGGCAGAA
ACACTGGGCAGCATGGCAGCTAACTGCTGTATTAAATTTGTCTCAAGAATATTGTG

TTGGCCAAGAAATTAACGCCAACCACATACGCGGTGTTTCGTTCCGGCATAGTGAC
TGGCACAGCAACGCTAGTACACAAAGGAAGAACCTCCCAGATTTGGGAAATTCG
CATCGTTAACGATCCAAAGAATTCAAAAAGCTTCTCGAGAGTACTTCTAGAGCGGCCG
CGGGCCCATCGATTTTCCACCCGGGTGGGGTACCAGGTAAGTGTACCCAATTCGCCCT
ATAGTGAGTCGTATTACAATTCCTGGCCGTCGTTTTAC

Figure 9:

Amino acid sequence of the stabilized single ring mutant Glu461Ala/Ser463Ala/Val464Ala of Cpn60:

SEQ ID No 14: Cpn10 (nucleotides 458-751 of Figure 10):

MKIRPLHDRIVRRRKEEETATAGGILPGAAAEKPNQGVVISVGTGRILDNGSVQALA
VNEGDVVVFGKYSGQNTIDIDGEELLILNESDIYGVLEA

SEQ ID No 15: Cpn60 (nucleotides 458-751 of Figure 10):

MAAKDVLFGDSARAKMLVGVNLADEVRTLGPGRNVVIEKSFGAPIITKDGVSV
AREIELKDKFENMGAQMVKEVASQANDQAGDGTATVLAQAISEGLKSVAAGMN
PMDLKRIGDKATAAVVAAIKEQAQPCLDTKAIAQVGTISANADETVGRLLIAEAMEKV
GKEGVITVEEGKGLEDELDDVEGMQFDRGYLSPYFINNQEKMTEVEMENPLILLVDKK
IDNLQELLPILENVAKSGRPLLIVAEDVEGQALATLVVNNLRGTFKVAAPGFGD
RRKAMLQDLAILTGGQVISEELGMSLETADPSSLGTASKVVIDKENTVIVDGAGTEAS
VNTRVDQIRAEIESSTSDYDIEKLQERVAKLAGGVAVIKVGAGSEMEMKEKKDRVD
DALHATRAAVEEGVVAGGGVALIRALSSVTVVGDNEDQNVGIALALRAMEAPIRQI
AGNAGAAGAAVVDKVKSGTGSFGFNASTGEYGDMIAMGILDPKAVTRSSLQAAASI
AGLMITTEAMVADAPVEEGAGGMPDMGGMGGMGGMGGMPGMM

Figure 10:SEQ ID No 16: DNA sequence of the stabilized single ring mutantGlu461Ala/Ser463Ala/Val464Ala:

In the DNA sequence:

Small letters – the Cpn10-Cpn60 coding fragment,

Big bold letters = introduced mutations

atcaaaaaatgcagcaaggacagattcctgcccagaattagcagaagggttctttagcactggccggcgcttattattaacgcccgg
 gtttgtcactgatgcgctgggtttacattactcgtccccgcgacgcgtaaacggttggtccataagggtgattgcatttattaccctc
 gcatgatgactgcaagcagctttcaagcgcggttagtttcaggaaggctcgtttaaagatgtacattcgacactgactcgcaaagca
 gtcatgaaaaaatcacaattgaaggcgaatataccaagacgataagtaggtatttttcggctagccgtgaaatcctagtaaaagccc
 cgataaattaaccatctattttcacagaggcaatttagccttgtttaccttattgatcctaatacttgggatccaacagtggagagtctagc
 aaatgaaaatccgtccattacatgatcgtattgtgttcgccgtaagaagaagagaccgcaactgcgggtggtattatttacc
 gggcgctgcggcagaaaaacaaatcaagggtgttgttctctgtgggtactggccgtattcttgataatggttcagtgcagcgctggc
 ggttaacgaaggcgatgtgtcgttttggttaatactcaggtcaaaatactatcgatcgtggaagaattattgatttgaatga
 aagtgatctacggcggtttagaagcttaattattacactcacitttttatctaactacaaaatgaaggaaagatcatggctgctaaagacg
 tattatttggtgatagcgcacgcgcaaaaatgttggttaggtgtaaacttttagccgacgcagtaagagttaccttaggacctaa
 aggtcgtaacgttgttatagaaaaatcatttggtgcaccgatcatcaccaaagatgggtgttctgttcgcgtgaaatcgaattgaaagaca
 aattcgaaaacatgggcgcacagatggttaaggaagttgcttctcaagccaacgaccaagccggtgacggcacaacgacagc gact
 gtactagcacaggcgattatcagcgaaggcttgaaatctgttcgggtggcatgaatccaatggatcttaaacgtggtattgataa agcta
 cggctgctgtgttgccgccattaaagaacaagctcagccttgcttgatacaaaagcaatcgctcaggtagggaacatctctgc caatg
 ccgatgaaacggttggtcgtttaattgctgaagcgatggaaaaagtcggtaagaagggtgtgattaccgttgaagaaggcaaag gcctt
 gaagacgagcttgatgtttagaaggcatgcagttcgatcgcggttactgtctccgtacttcacacaaccaagaaaaaatgac cgta
 gaaatggaaaatccattattctattggttgataagaaaattgataaccttcaagagctgttgccaattcttgaaaacgtcgctaaatc aggt
 cgtccattattgatcgttgctgaagatgttgaaggccaagcactagcaacattggtagtaaacaacttgcgcggcacattcaaggttgc
 agcgggttaaagcccctgggtttggcgatcgtcgtaaagcgatgttgcaagatcttgccatcttgacgggtggtcaggtatttctgaagag
 ctagggatgtcttagaaactgcggatccttcttcttggttacggcaagcaagggtgttatcgataaagaaaacaccgtgattgttga
 tggcgcaggtactgaagcaagcgtaatactcgtgttgaccagatccgtgctgaaatcgaaagctcgacttctgattacgacatcgaaaa
 gttacaagaacgcgttgctaagcttgcggggcggttgccgtgattaagggttggtgcgggttctgaaatggaaatgaaagagaagaaa
 gaccgtgtgacgatgcacttcacgaactcgcgcagcggttgaagaagggtgtgttgctgggtggtgtgttgcttgattcgcgcaactct
 cttcagtaaccgttgttggtgataacgaagatcaaaacgtcggtattgcattggcacitcgtgcgatggaagctcctatccgtcaaatcgc

gggtaacgcaggtgctgCagggGcagCggtgttgataaagtgaatctggcacaggtagctttggtttaacgccagcacaggtg
agtatggcgatatgattgcgatgggtatttagaccctgcaaaagtcacgcgttcattctctacaagccgcggcgtctatcgcaggtttgat
gatcacaaccgaagccatggttgcggtatgcgcctgttgaagaaggcgtgggtgtatgcctgatatgggcggcatgggtggaatggg
cggatgcctggcatgatgtaatcactttgtgattcattgtcctgatctgcttaccgtgtaaaaagatcaggctcaaggctgtctctataaaa
agccgtatctttgatgagtgttcttctgctgaaaacgacattctggagtgcggttttttgatttggtcataaaattcagaatattgtga
atttatgtaactagctggcctataatgttgagttcctctgggtggcatgatctcatggtacttcacttaagcctgattcactgcg
gctttaacagtaaaataataacgcaacgtagaaacataataagcgtatggcattaatgaagacggctgcatttaattcagatc

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